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A STUDY TO DETERMINE

THE SUCCESS OF IMPLEMENTING THE WORKLOAD MANAGEMENT SYSTEM FOR NURSES AT MONCRIEF ARMY COMMUNITY HOSPITAL

A Graduate Management Project

Submitted to the Faculty of

Baylor University

In Partial Fulfillment of the

Requirements for the Degree

of

Master of Health Care Administration

by

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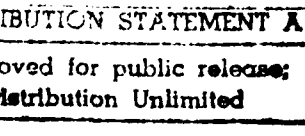

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A descriptive study of the Workload Management System for Nurses (WMSN) was performed at Moncrief Army Community Hospital, Fort Jackson, South Carolina from 1 July to 16 December 1988. Descriptive and correlational statistics were generated from data collected from three medical/surgical nursing units to demonstrate professional and ancillary utilization, overall unit staff availability, and the impact of staffing adjustments upon utilization. After segregating the data for each unit into four homogeneous groups by shift and day of the week, comparisons of utilization information were made to nursing care hours, census, and changes in census. The study supported the contention that staff were being moved, in part, as a function of the elements of the WMSN. The availability of staff to be moved to meet nursing care needs was found to be a significant limiting factor. The need for follow-up studies and the routine use of the actual staffing Utilization Ratio as a means of communicating staffing needs to the hospital leadership were recommended.

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I. INTRODUCTION.

1. CONDITIONS WHICH PROMPTED THE STUDY.

In January 1985, the Department of Nursing at Moncrief Army Community Hospital, along with other Army hospitals, began using the Workload Management System for Nurses (WMSN) on its inpatients nursing units. This sophisticated patient classification system was the result of many years of arduous research conducted by nurse researchers in the Health Care Studies Division at the Academy of Health Sciences, Fort Sam Houston, Texas and the Nursing Research Service at Walter Reed Army Medical Center. It permitted the Departments of Nursing to accurately classify their patients into mutually-exclusive categories reflecting the intensity of the patient's nursing needs with the goal of providing a unit staffing mix based on the patient care requirements.

Three and a half years later, the Chief Nurse, Moncrief Army Community Hospital asked the question, "Have we been successful in implementing the WMSN?" This question is an important one from a nursing management standpoint but it is one that is not easily answered. Interrater reliability measures are a integral part of the on-going evaluation of the WMSN classification tool but, despite the enormous amount of work that went into the

development of the WMSN, there is no stated measure of "success" of the WMSN program implementation at any given medical treatment facility (MTF).

The challenge of the question becomes three-fold. First, the goal(s) of patient acuity systems in general, and the WMSN in particular, at the MTF level must be determined. Second, the goal(s) must be translated into quantifiable terms that can measure goal achievement, or "success". Third, one must determine the variables which impact positively and negatively on attaining the goal(s) to explain why the goal(s) was or was not achieved.

2. PROBLEM STATEMENT.

To determine the changes in staffing allocation, acuity levels, and nursing unit activities as they relate to changes in a Workload Management System-based utilization ratio. The ratio effects shall serve as a measure of success in the implementation of a patient classification system.

3. CRITERIA. All statistical tests will be considered significant at the Alpha = .05 level.

4. ASSUMPTIONS.

a. When a valid, reliable, and objective system of allocating human nursing resources is provided to a Department of Nursing, it will become the primary means of allocating such resources.

b. The WMSN information collected and reported daily from the nursing units is valid and reliable.

c. Nursing units and supervisors are unaware of the complete methodology and hypotheses of this study, eliminating the Hawthorne effect.

5. LIMITATIONS.

a. This project must be completed within one year.

b. The data collection period will cover the last six months of 1988 due to the availability of reliable data. Therefore, the information gleaned from this data will not reflect seasonal changes in staff utilization.

c. There are only three nursing units in the institution under study which use the same WMSN Recommended Staffing charts based on nursing care hours within specialty services.

6. OTHER FACTORS LIMITING THE METHODS OF RESEARCH.

a. This medium-sized Army community hospital has experienced a continuing decreasing trend of average daily census over the past decade. This has negatively affected the nursing manpower allocation to this facility over the years.

b. The hospital uses the Uniform Chart of Accounts and Personnel (UCAPERS) automated system to report acuity and staffing. Unfortunately this system has been plagued with system failures, unpredictable down time, and user entry errors. The

actual documents used to collect and enter data into the UCAPERS system must be used rather than the computer-generated information to ensure reliability of the data.

c. Data was only collected on the day and evening shifts based on input from the clinical supervisors. They indicated that between the three units on which data was being collected: (1) historically, the night shift was the most austerely staffed of the three shifts, and (2) staffing levels for both professional and paraprofessional staff were equal and consistent. Regardless of weekday or weekend/holiday, these units had one professional nurse and one ancillary staff member on duty during the night shift. They also stated that the fewest staffing adjustments were made during the night shift.

B. LITERATURE REVIEW.

Short History of Patient Classification Systems

The history of patient classification systems in the United States spans slightly over a half a century. In a 1973 Department of Health, Education, and Welfare publication, Aydelotte reviewed selected literature on staffing methodologies. In the first study of institutional nursing in 1922, the New York Academy of Medicine noted an adequate amount of bedside nursing

time per patient to be five hours and four minutes in a 24-hour period. A National League of Nursing Education and American Hospital Association Division of Nursing publication in 1936 further refined adequate bedside hours per patient per day into eight different age or disease categories. This is the first evidence of formally recognizing the need to differentiate nursing care hours based on individual patient needs. The first major effort to classify patients based on the care they required was undertaken by Robert Connor at Johns Hopkins in 1960 (ctd in Kirby 1986, 305).

In an article written by Vaughn and MacLeod (1980), nursing staffing studies and the ultimate objectives of such studies were discussed. This study states that there is a tactical and a strategic objective for nurse staffing studies. The establishment of a system that balances manpower requirements with available nursing staff on each unit for each shift is the "tactical" objective. The summarizing of data on "actual" versus "required" staff to provide feedback for long-range decision making regarding budgeted nursing staff by shift for each unit is the "strategic" objective. The overall objective of these studies is to develop a nurse staffing system based on patient classification that facilitates the allocation of nursing resources based on nursing care needs.

It should be noted that the need for matching the individual nursing needs of a patient to nursing staff assignment is not a new phenomenon in modern professional nursing. The efficient utilization of nursing personnel and its link to illness are located in the 19th century writings of the founder of modern nursing. In her classic 1859 book, Notes on Nursing, What It Is and What It Is Not, Florence Nightingale recognized that an individual patient's nursing requirements should be matched to nursing resources when she wrote,

> One sick person is often waited on by four with less precision, and is really less cared for than ten who are waited on by one; or at least than 40 who are waited on by 4 . . . (24)

Classification, in the generic sense, is a means of grouping something according to observable or inferred properties or characteristics. As it applies to nursing, patient classification is the placing of patients into mutually exclusive groups according to a formal assessment of their nursing needs over a given time period. Patient groupings or categories are usually developed in terms of the amount of nursing care required (Ruman, Krueger, and Nelson 1988, 10). The term acuity refers to how acutely ill a patient is, and is usually reflected in the amount of nursing care he or she requires and the category into which the patient is placed by the classification system (Grohar,

Myers, and McSweeney 1986, 20). Any methodology developed for this process is a patient classification or patient acuity system.

Types of Patient Classification Systems

According to Philibert (1986), all patient acuity or classification systems make three assumptions: (1) the nursing process is measurable, (2) the activities in the nursing process constitute a measurable set of interrelated functions, and (3) individual patient nursing needs can be identified (60). Johnson (1984) describes the four elements found within any patient classification system. These elements are: (1) a method for grouping patients, (2) guidelines for classification methodology, frequency of classification, and reporting methods, (3) average patient care times required for each category, and (4) the mathematical means to determine required staffing and nursing care hours (39). There is no consistency, however, in the way individual healthcare institutions measure the nursing process or patient nursing needs.

The two most common methods for grouping patients are identified by Abdellah and Levine (ctd in Giovanetti 1979) as factor and prototype evaluations (5). A prototype, or "subjective" classification system uses a descriptive profile of

the nursing care required for a "typical patient" in each patient category. Nurses use these descriptions to classify each patient on their unit by how well they fit into a particular category. An example of this form of acuity system is described by Georgette (1970).

A patient classification system that uses a factor or "objective" classification system divides nursing care into specific nursing requirements, or "critical indicators of care" as they are sometimes called, that are associated with the nursing care of a patient. These critical indicators represent those activities having the greatest impact on nursing care time. Using expert judgement, time and motion studies, or a combination of both, the average amount of time needed to perform selected tasks is estimated. Points for all nursing tasks to be performed for a patient are summed to obtain a total score that is associated with a particular patient category (Ruman, Krueger, and Nelson 1988, 10, and Giovanetti 1979, 5).

Quantification of the nursing care resources required for each category of patient is an inherent part of a patient classification system. Giovanetti (1979) states that the two common methods for accomplishing this purpose are: (1) average care times per patient category and (2) standard care times per specific nursing procedure or critical indicator.[1] She emphasizes, however, that "average care times or standard times

are not necessarily the same from institution to institution or even from one nursing unit to another" due to the multifaceted nature of care time determinations (5-6). She suggests that each healthcare institution determine their own index of workload because of this inability to transfer quantification measures.

This idea of nontransferability of quantification measures is not universally shared. Marks (1987) believes that "standard definitions about which nursing activities are included or excluded [in the classification systems, and] . . . standard methods for computing them" are not only possible but necessary in pinpointing and capturing nursing costs (43). The recommendation for developing a standard approach to quantifying workload that could be shared among institutions had been suggested in 1980 by Vaughan and MacLeod.

To illustrate the feasibility of standardization, a study was conducted by Schroeder, Rhodes, and Shields in 1984 at the Malcolm Grow Medical Center in Washington, D.C. At this facility, two nursing acuity systems were tested for future use: (1) the CASH acuity system developed by the Commission for Administration Services in Hospitals, and (2) the GRASP system designed by Grace Hospital in Morgantown, North Carolina. These two generic systems were chosen because they used different methods for determining staff requirements. Their study revealed insignificant differences in the final registered nurse staffing

requirements. One system was eventually chosen over the other for implementation because it was less time-consuming to operate and easier to implement (77).[2]

The Workload Management System for Nurses

The United States Army has been a maverick in the area of patient classification and its use in resource allocation during the past decade. In September, 1981, Sherrod, Rauch, and Twist submitted the Nursing Care Hour Standards (NCHS) Study. The intent of their study was:

> . . . to develop an improved patient classification system which would provide a better staffing mix based on quantified direct nursing care requirements for critical care, medical/surgical, obstetric, psychiatric, neonatal, and pediatric inpatient clinical services (v).

The Sherrod NCHS study was conducted over a four year period under the auspices of the Health Care Studies Division, Academy of Health Sciences, Fort Sam Houston, Texas. The study was conducted in response to a void within the current nursing managerial arena for "a valid, reliable, multidimensional, factor-evaluation designed patient classification system" to establish patient care needs and staffing mix by the care

provider skill level of care providers (3). The drawback of the study was that it relied entirely on direct patient care measurements to determine staff mix and patient requirements. Although the Sherrod NCHS study made an extremely thorough assessment of direct patient care requirements through painstaking time-in-motion studies, they did not take into account the indirect patient care time.

Sherrod, Rauch and Twist (1981) defined direct patient care, the focus of their study, as "All care given by nursing personnel in the presence of patients; those nursing activities that are carried out with or for the patient, are behavioral in nature, and are observable" (4). All data collection was centered on activities that fit this definition and all staffing mix ratios developed in this study were based on direct patient care. What was not measured was the time spent by various nursing care providers in indirect patient care and time unavailable for patient care.

To fill the indirect care void left by the Sherrod study, Misener, Frelin, and Twist completed their study of "Time Spent in Indirect Nursing Care" in August, 1983. Using a work sampling technique, Misener and his associate investigators examined patient care in terms of indirect patient care activities and activities that render nursing personnel unavailable for care. Indirect patient care activities are defined in this study as

patient-centered activities performed away from the patient and were broken down into eight substrata: communicative acts; preparation of medications, supplies, and equipment; clerical and charting; conferences; travel and transportation; administration; environmental controls, and wait time (Misener, Frelin, and Twist, 1983, iv). Unavailable for care activities include: (1) Personal Activities, such as meal time, personal telephone calls, socialization not related to work, personal toilet activities, and coffee breaks, and (2) Off Unit Activities which removes an individual from the ward for less than a full eight hour shift and does not involve patient care (13-A).[3]

In September, 1982, Brigadier General Connie L. Slewitzke, Chief of the Army Nurse Corps tasked LTC James D. Vail, Chief, Nursing Research Service, Walter Reed Army Medical Center, to develop, test and implement a valid and reliable system for classifying patients based on their nursing care hour requirements. This system was to be linked to a staffing methodology which used patient care needs to determine the number and mix of personnel required to provide nursing care (5). Vail, Norton, and Rimm (1986), working in collaboration with Commander Karen Rieder, Navy Nurse Corps, produced the Workload Management System for Nursing (WMSN). This system, which combines an objective factor-evaluation patient classification system and a linking staffing methodology, incorporates the findings and

recommendations of both the Sherrod NCHS study and the Misener Indirect Nursing Care study (7-8).[4]

Evaluating a Patient Classification System

All systems must ultimately be evaluated for their effectiveness. In order to evaluate a system, the purpose of the system and the activities that support that system must be known. The WMSN was designed to classify patients according to their nursing care needs, then provide nurse managers with a staffing guide of number and mix of provider to best allocate nursing resources to meet the patient's identified nursing care requirements. Therefore, the ultimate purpose of the system is to provide "a mechanism for effective allocation and utilization of nursing resources" (Vail, Norton, and Rimm, 1986,1-2). The supporting activity is the effective use of the patient classification tool.

The patient classification tool of the WMSN is directly in support of the standards set forth by the Joint Commission on Accreditation of Healthcare Organizations (JCAHO). In its standard for nursing services, the JCAHO requires the nursing department to "define, implement, and maintain a system for determining patient requirements for nursing care on the basis of demonstrated patient needs, appropriate nursing intervention, and

priority of care" (JCAHO, 1988, 138). The WMSN takes this standard a step further and uses the classification system to allocate nursing resources using developed staffing guides. The validity and reliability of the tool becomes tantamount to the success of the ultimate objective of resource allocation.

The requirement for a valid and reliable patient classification tool in a patient acuity system can be found throughout the literature (Giovannetti, 1979; Ebener, 1985; Unger, 1985). The WMSN employs regular interrater reliability testing and centralized reporting by each using activity as a continuing evaluation technique for the tool. It must be mentioned, however, that, in its present form, interrater reliability for the WMSN primarily evaluates the documented care given rather than nursing care requirements based on nursing standards of care. Realizing that the development of a classification system must, by its very nature, be dynamic and evolutionary rather than a static, methods of interrater reliability in the WMSN will gradually change to reflect verification of nursing care requirements as nursing care standards are established.

It becomes important to determine the "success" of the ultimate objective for the system, the utilization and allocation of human resources, since the current validity and reliability evaluation has been accepted by the organization as sufficient

for the present. Unfortunately there is a void in the literature with regard to this process. Powers (1984), in her description of a classification system used at Mercy Hospital in Port Huron, Michigan, states that the reports generated by the system "point out the units with underused or overused resources"(36). There is no mention on what data is used to determine this.

Although there is no mention of resource allocation evaluation in the Vail, Norton, or Rimm (1986) study, Rieder and Lensing (1987), in a discussion of the development of a systems model of nursing productivity and the WMSN, suggest the use of efficiency and efficacy ratios as a means of determining total nursing productivity. They state that the nursing care hours (NCH) are the intermediate products of the nursing centers and can be used in the aforementioned ratios as a possible means of determining overall nursing productivity (39). However, the objective is to evaluate resource allocation and this cannot be done with nursing care hours alone.

The WMSN uses the NCH in conjunction with staffing tables to determine the numbers and mix of patient care providers for various inpatient units by specialty service. Since the WMSN has this capability, the changes in the quantity and provider mix during a shift to balance requirements with resources could prove

to be most valuable in determining the "success" of implementing a nursing classification system. One must first, however, find a measure that demonstrates staff utilization.

Hanson (1983) provides a utilization ratio that can be used with the WMSN. The ratio of required staff to provided or actual staff when multiplied by 100 gives staff utilization information that can be useful in demonstrating trends in staff allocation (259-261). The required staffing represents the workload input in the patient care system in terms of human resource requirements. The actual staffing represents the capacity of the system to output the work in terms of human resources. This ratio is consistent with the classical definition of productivity, which is the relationship between inputs and outputs.

An article by Norby, Freund, and Wagner (1977) is helpful in demonstrating the bridge between productivity and utilization ratio suggested by Hanson. They employ the relationship of workload, measured in difficulty units, to the capacity of the staff to do the workload as a utilization measure to determine staffing coverage requirements (4). Translating this into Hanson's equation, workload can be measured by the number of persons required to perform a specific amount of work determined

by a workload management system. The capacity of the system to do the work can be measured by the number of actual human resources available to do the specified amount work.

C. METHODOLOGY:

1. An extensive literature review was performed to assess the: (1) purposes of patient classification systems, (2) methods of evaluating the success of implementing a patient classification systems and their relationship to productivity measures, (3) methods to assess trends when using patient classification systems, and (4) purpose, reliability and validity indices, means of evaluation, and future uses of the current Workload Management System for Nurses (WMSN) used by the U.S. Army.

2. A utilization measure to serve as the dependent variable was selected using expert validity. LTC Valerie Biskey, AN, Nurse Researcher at the Health Care Studies Branch, Academy of Health Sciences, Fort Sam Houston, Texas, recommends using a productivity measure found in the literature (Hanson, 1983) that is a ratio of recommended to actual staffing. The utilization measure that will serve as the dependent variable is the difference between two utilization ratios described below. The difference of the two ratios was chosen because it would reflect not only a change in staffing but also the degree that the change

affected the overall utilization of staff during a particular shift. Operational definitions of these ratios can be found at Appendix B.

a. The first ratio is the Utilization Ratio-Scheduled. Unit time schedules were used to establish the number of professional and ancillary staff, as Full Time Equivalents (FTE), scheduled to work on a particular day and shift.

b. The second ratio is the Utilization Ratio-Actual. Unit time schedules were used to establish the number of professional and ancillary staff scheduled to work on a particular day and shift.

c. The Utilization Ratio-Actual is subtracted from the Utilization Ratio-Scheduled to give a net change (delta) in the staffing ratio during the shift. This net change in the Utilization Ratios (Utilization Ratio-delta) will be the dependent measure. A positive change would reflect staffing augmentation. A negative change would reflect staffing depletion as staff were pulled to work on other units. As a variable, it represents the degree of enhanced or diminished staff utilization by either staffing augmentation or depletion respectively.

3. Three nursing units at Moncrief were selected as data collection sites. All three units shared two important common features; they all exclusively used the same Medical-Surgical WMSN patient classification tool and staffing table to determine

type and mix of required staff. Homogeneity in the use of a single classification tool and staffing table among the different units was the most important criteria in the date collection site selection since the dependent measure is derived from both acuity and staffing table data.

a. The three units selected were representative of general medical or surgical units at this institution. Ward 9 East is a medical nursing unit consisting of primarily chronically ill and oncology patients. Wards 10 East and 10 West are mixed surgical units caring for primarily orthopedic, podiatry, otolaryngologic, and general surgery patients.

b. Although another medical nursing unit, Ward 8 West, exists at Moncrief, it was not considered an acceptable data collection site. This unit uses two different patient classification tools and staffing tables to determine patient acuity and staffing mix because of its dual missions of caring for patients with acute respiratory disease (medical) and pediatric (both surgical and medical) patients.

4. The time frame from 1 July to 16 December 1988 was used to collect data on the three selected inpatient units.

a. These time periods were chosen to permit completion of the Graduate Management Project by the end of the Residency Period and because of staff and unit consolidation on 18 December following the exodus of trainees during the holiday season.

b. Data were collected from each of the three nursing units on 88 weekdays and 48 weekend-holidays randomly selected using a table of random numbers, to give a Confidence Level of 0.95 and a Precision Level of 0.05.

c. The data collected on all three units were for the same weekdays and weekend-holidays.

d. The data were collected for the day and evening shifts. These two shifts were selected based on discussions with the Medical and Surgical nursing supervisors, and the evening and night nursing supervisors. The supervisors indicated that because the day and evening shifts were better staffed than the night shift, there was a greater probability of in-house staffing manipulation on these two shifts to meet nursing care requirements. Therefore, changes in the dependent measure were more likely to occur on the day and evening shifts.

5. Utilizing the data and the documents used to prepare monthly workcenter reports from the three inpatient units, data were collected for the day and evening shifts regarding the following variables, described more completely in Appendix B.:

a. Scheduled and actual Professional and Ancillary staffing by shift,

b. Recommended (WMSN) Professional and Ancillary staffing by shift.

c. Shift staffing adjustments by level of provider.

d. Census.

e. Changes in census.

f. Level of provider (professional/paraprofessional)

g. Day of the week (weekday/weekend-holiday)

h. The ratio of assigned to Table of Distribution and Allowances (TDA) authorized professionals and ancillary staff.

i. Actual Nursing Care Hours.

6. Compare the nursing care hours of each of the three inpatient units during the time period listed in 4 above, and test for statistical significance using a One Way ANOVA for three independent means with independent t contrasts.

7. Perform a correlation analysis using Pearson's product-moment r on the Utilization Ratio-delta and independent factors (4c-i, above) and examine correlation matrices for trends among the dependent and independent variables.

8. Make recommendations to the Chief, Department of Nursing with regard to changes that may be beneficial in improving the use of the WMSN data in allocating inpatient nursing staff resources.

9. Make recommendations for future studies.

NOTES

[1]. Phyllis Giovannetti (1979) provides an excellent description of the quantification of patient care in the development of a patient classification system (5-6). The use of observational studies, such as those used by Sherrod et al., and standard time manipulations, as used by Misener et al., contributed to the ultimate design of the WMSN. The WMSN demonstrates an effective blend of quantification processes described by Giovanetti.

[2]. The article by Schroeder, Rhodes, and Shields gives a comprehensive explanation of the differences between the two types of patient acuity systems (73-74). It can be gleaned from this article that the terms "patient classification design", "subjective design", "category oriented", and "prototype", when describing a patient acuity system, all describe the same type of system design. It also follows that the terms "workload measurement design", "objective design", "task oriented" and "factor design", when describing a patient acuity system, likewise describe the same type of system design.

[3]. Misener, Frelin and Twist (1983) give the operational definitions of their indirect patient care activities in Appendix

13 of their study (13-A). A review of this appendix would give the reader a more comprehensive view of the vast number of indirect patient care activities, especially in the "off unit activities" in the military patient care setting that interfere with a health care provider's ability to deliver care.

4. The literature review gives a highlighted and very condensed history of the development of the WMSN. For a more detailed account of the development of the system, which includes the work of COL Beverly Glor and the Health Management Systems Associates of Minneapolis, the reader is directed to the Prologue of the Vail, Norton, and Rimm (1986) study (2-6).

II. DISCUSSION

Descriptive Measures and Data Stratification

The descriptive statistics for the three nursing units and the variables studied are shown on Tables 1 and 2. The data were initially separated into day and evening shift because the WMSN uses two separate and distinct sets of staffing requirements for those shifts. This ultimately affects the utilization ratios for each unit and shift and the homogeneity of the data.

Tables 3 through 6 display the descriptive statistics for the same nursing units grouped by shift and weekday or weekend-holiday. This was done for two reasons. First, the WMSN requirements specify that a Head Nurse and Wardmaster be included as additional requirements to the staffing guide on the weekday day shift. Although by the design of the WMSN staffing guide these individuals are added to work primarily in an administrative capacity, in reality they are primarily involved in direct patient care. Second, census is normally lower for the weekends and holidays. This affects both nursing care hours and scheduling. Both of these factors would affect the utilization ratios of the three units, and supervisory judgement when considering shifting staff.

Table 1

Measures for the Day Shift

Variable	Ward 9 East Gen Med N=136		Ward 10 East Gen Surg N=136		Ward 10 West Gen Surg N=136	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Census	19.76	3.90	14.76	3.90	13.60	3.98
Census-delta	-0.50	2.17	-0.33	2.56	-0.15	2.46
N.C.H.[a]	101.39	29.02	54.88	17.73	72.27	20.25
PUR-Actual[b]	1.25	0.37	1.08	0.52	1.41	0.77
PUR-delta	0.07	0.28	-0.14	0.34	0.06	0.38
Professional						
TDA Ratio	1.09	0.14	1.09	0.07	0.91	0.11
AUR-Actual[c]	1.02	0.50	0.99	0.51	1.19	0.53
AUR-delta	-0.01	0.14	-0.03	0.10	0.03	0.19
Ancillary						
TDA Ratio	1.36	0.07	0.93	0.04	0.93	0.14

[a]Nursing Care Hours (N.C.H.)

[b]Professional Utilization Ratio (P.U.R.)

[c]Ancillary (Paraprofessional) Utilization Ratio (A.U.R.)

Table 2

Measures for the Evening Shift

Variable	Ward 9 East Gen Med N=136		Ward 10 East Gen Surg N=136		Ward 10 West Gen Surg N=136	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Census	20.05	4.03	14.80	4.00	13.79	4.06
Census-delta	0.30	1.38	0.04	1.70	0.24	1.20
N.C.H.	101.39	29.02	54.88	17.73	72.27	20.25
PUR-Actual	1.10	0.40	0.90	0.27	1.18	0.49
PUR-delta	0.08	0.42	-0.06	0.19	-0.03	0.20
Professional						
TDA Ratio	1.09	0.14	1.09	0.06	0.91	0.11
AUR-Actual	1.22	0.49	0.90	0.41	1.14	0.48
AUR-delta	-0.01	0.13	-0.02	0.12	0.04	0.49
Ancillary						
TDA Ratio	1.36	0.07	0.94	0.04	0.98	0.14

A One-Way ANOVA was performed on the independent variable nursing care hours for all three nursing care units for the day shift. Since compilation of nursing care hours is done only once a day during day shift, it makes no difference whether the N.C.H. estimates are used from day shift or evening shift. They would be the same number. The result was $F(2,405)=143.853$, $p<.001$.

Contrasting t tests were performed on each on the three units. The results are displayed in Table 7. It is concluded that each of the three nursing units is statistically different from the other with regard to the nursing care requirements of their patients. This is translated by the WMSN into different staffing requirements. Therefore, each nursing unit will be treated as a separate homogeneous group.

Separate t tests were also performed on the Nursing Care Hour data from each nursing unit to assess the appropriateness of segregating the data based on shift and day of the week. The results of the t test are found in Table 8. The smaller t value for 9 East was expected since this nursing unit cares for a large number of chronically ill patients. There would be less turnover of patients on the weekend as is more commonly seen on surgical nursing units. This smaller turnover of patients on the weekend/holidays is demonstrated by the Census-delta in Table 5.

It was deemed appropriate to further stratify the data to reflect the differences in nursing care hours on the weekdays and

weekend-holidays based on the results of the t tests. The stratification will further organize the data into more homogeneous groups. The final grouping of data to be used for the remaining analyses mirrors the presentation of the descriptive statistics in Tables 3 through 6; by nursing unit, shift, and weekdays versus weekends/holidays.

Table 3

Measures for the Day Shift - Weekdays

Variable	Ward 9 East Gen Med N=136		Ward 10 East Gen Surg N=136		Ward 10 West Gen Surg N=136	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Census	20.33	3.76	15.50	3.75	13.85	3.90
Census-delta	-0.66	2.44	-0.09	2.71	0.16	2.70
N.C.H.	105.41	28.34	61.58	15.55	79.44	18.47
PUR-Actual	1.24	0.37	1.12	0.59	1.46	0.85
PUR-delta	0.10	0.31	-0.17	0.37	-0.10	0.43
Professional						
TDA Ratio	1.08	0.13	1.09	0.07	0.91	0.11
AUR-Actual	1.12	0.50	0.99	0.54	1.15	0.45
AUR-delta	-0.01	0.09	-0.04	0.12	0.05	0.24
Ancillary						
TDA Ratio	1.36	0.07	0.93	0.04	0.97	0.14

Table 4

Measures for the Evening Shift - Weekdays

Variable	Ward 9 East Gen Med N=136		Ward 10 East Gen Surg N=136		Ward 10 West Gen Surg N=136	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Census	20.69	3.91	15.50	3.87	13.87	4.04
Census-delta	0.39	1.49	-0.01	1.93	0.10	1.29
N.C.H.	105.41	28.34	61.58	15.55	79.44	18.47
PUR-Actual	1.09	0.40	0.87	0.32	1.26	0.56
PUR-delta	0.11	0.52	-0.08	0.22	-0.04	0.25
Professional						
TDA Ratio	1.08	0.14	1.10	0.06	0.91	0.11
AUR-Actual	1.21	0.51	0.93	0.48	1.20	0.49
AUR-delta	0.01	0.12	-0.02	0.13	-0.01	0.09
Ancillary						
TDA Ratio	1.36	0.07	0.92	0.04	0.97	0.14

Table 5

Measures for the Day Shift - Weekend/Holidays

Variable	Ward 9 East Gen Med N=136		Ward 10 East Gen Surg N=136		Ward 10 West Gen Surg N=136	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Census	18.73	3.99	13.40	3.87	13.15	4.14
Census-delta	-0.21	1.54	-0.77	2.23	-0.71	1.87
N.C.H.	94.02	29.11	42.58	14.71	59.10	16.51
PUR-Actual	1.29	0.37	0.99	0.36	1.32	0.60
PUR-delta	0.01	0.20	-0.09	0.28	-0.04	0.25
Professional						
TDA Ratio	1.09	0.14	1.10	0.06	0.91	0.11
AUR-Actual	1.36	0.46	0.99	0.44	1.26	0.66
AUR-delta	0.01	0.21	-0.01	0.07	-0.01	0.04
Ancillary						
TDA Ratio	1.36	0.07	0.93	0.04	0.98	0.14

Table 6

Measures for the Evening Shift - Weekend/Holidays

Variable	Ward 9 East Gen Med N=136		Ward 10 East Gen Surg N=136		Ward 10 West Gen Surg N=136	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Census	18.88	4.02	13.52	3.95	13.63	4.14
Census-delta	0.15	1.15	0.13	1.18	0.48	0.99
N.C.H.	94.02	29.11	42.58	14.71	59.10	16.51
PUR-Actual	1.11	0.41	0.96	0.11	1.03	0.28
PUR-delta	0.02	0.11	-0.01	0.04	-0.01	0.07
Professional						
TDA Ratio	1.09	0.14	1.11	0.06	0.91	0.11
AUR-Actual	1.24	0.44	0.85	0.24	1.02	0.46
AUR-delta	-0.05	0.16	-0.02	0.08	0.15	0.81
Ancillary						
TDA Ratio	1.08	0.07	0.93	0.04	0.99	0.14

Table 7

Differences Between Means for Nursing Care Hours Combined Weekday and Weekends/Holidays.

Units Compared	Results
9 East vs 10 East	t(270) = 15.9498, p<.001
9 East vs 10 West	t(270) = 9.5976, p<.001
10 East vs 10 West	t(270) = 17.5355, p<.001

Table 8

Differences Between Means of Weekday and Weekend/Holiday Data for Nursing Care Hours On Individual Nursing Units.

Units	Results
9 East	t(134) = 2.2182, p<.05
10 East	t(134) = 6.9359, p<.001
10 West	t(134) = 6.3646, p<.001

Testing the Dependent Measures

A One-Way ANOVA was performed on the Professional Utilization Ratio-delta and Ancillary Utilization Ratio-delta data. The results are found in Tables 9 and 10 respectively. Contrasting t tests were performed on the Professional Utilization Ratio-delta data for the three nursing units on the Weekday-Day Shift and the Weekday-Evening Shift. These test results are found in Tables 11 and 12.

Overall staffing movement and its relation to the impact on professional utilization is demonstrated by Tables 11 and 12. Of the two surgical units, 10 East demonstrated a greater tendency to have their professional pulled to other nursing units during the weekday day shift. Units 9 East and 10 West demonstrated no statistically significant difference in the movement of professional staff during this same time frame, although when one compares the t test information in Table 11 to Table 3, it is evident that 9 East primarily received professional personnel during this shift whereas 10 West had personnel pulled. Similarly, according to Table 12, there was a greater tendency during the evening shift on weekdays to augment the professional staff on 9 East than on either 10 East or 10 West.

Contrasting t Tests were performed on the Ancillary Utilization Ratio-delta data for the three nursing units for the weekday day shift. These test results are found in Table 13. They indicate a statistically significant tendency to augment the ancillary staff of 10 West during this time frame whereas 9 and 10 East's ancillary staff tended to be pulled. If one examines Table 3 and views it in relation to the information in Table 13, one can see that a much smaller average changes in the delta and standard deviation than found in the professional data.

Table 9

One-Way ANOVA on Professional Utilization Ratio-delta

Day of Week	Shift	F
Weekday	Day	$F(2,261) = 15.641$, $p < .001$
Weekday	Evening	$F(2,261) = 7.121$, $p < .001$
Weekend/Holiday	Day	$F(2,141) = 1.981$, n.s.
Weekend/Holiday	Evening	$F(2,141) = 2.639$, n.s.

Table 10.

One-Way ANOVA on Ancillary Utilization Ratio-delta

Day of Week	Shift	F
Weekday	Day	F(2,261) = 7.411, p<.001
Weekday	Evening	F(2,261) = 1.665, n.s.
Weekend/Holiday	Day	F(2,141) = 0.011, n.s.
Weekend/Holiday	Evening	F(2,141) = 2.301, n.s.

Table 11.

Differences Between Means for Professional Utilization Ratio-delta for Data on the Weekdays During the Day Shift

Units Compared	Results
9 East vs 10 East	t(174) = 5.2229, p<.001
9 East vs 10 West	t(174) = -0.1270, n.s.
10 East vs 10 West	t(174) = -4.5783, p<.001

Table 12.

Differences Between Means for Professional Utilization Ratio-delta for Data on the Weekdays During the Evening Shift

Units Compared	Results
9 East vs 10 East	t(174) = 3.1848, p<.01
9 East vs 10 West	t(174) = 2.4860, p<.01
10 East vs 10 West	t(174) = -1.1142, n.s.

Table 13.

Differences Between Means for Ancillary Utilization Ratio-delta for Data on the Weekdays During the Day Shift

Units Compared	Results
9 East vs 10 East	t(174) = 2.4738, p<.05
9 East vs 10 West	t(174) = -2.0236, p<.05
10 East vs 10 West	t(174) = -3.2919, p<.001

A correlation matrix was generated for each of the homogeneous groups identified in this study for each dependent and independent variable. The r measurements for the correlation of the dependent variables Professional Utilization Ratio-delta and Ancillary Utilization Ratio-delta are given in Tables 14-21. It can be seen that there are few statistically significant correlations between the two proposed dependent variables and independent variables. There are no consistent correlational trends either between the three nursing units and the independent variables, or among the r values in the four time groups.

Professional Staff Correlations

The following observations regarding the professional staff can be made from those r values on Tables 14 through 17 having a less than five percent probability of occurring by chance alone:

Ward 9 East. On the day shift, most staffing augmentation efforts could not compensate enough to improve the overall professional utilization to an optimal level, regardless of the degree of enhanced utilization as a result of the augmentation. This is seen not only in the statistic but also by viewing the actual data and comparing the Professional Utilization

Ratio-actual with the corresponding Professional Utilization Ratio-delta. The t test results shown in Table 11 have already pointed out that during the weekday day shift, 9 East was the unit most likely to receive staff augmentees. The raw data demonstrate that at no time were professional registered nurses pulled from 9 East during the weekday day shift, and when the staff was augmented, the professional staff continued to remain overutilized.

During the 48 days examined on the weekend/holiday day shift, this unit only had one registered nurse pulled to another unit on one day, and the Professional Utilization Ratio-actual for that shift demonstrated staff underutilization. Likewise, there was only one period that the professional staff was augmented during this time frame. The resulting Professional Utilization Ratio-actual demonstrated that the professional staff was overutilized.

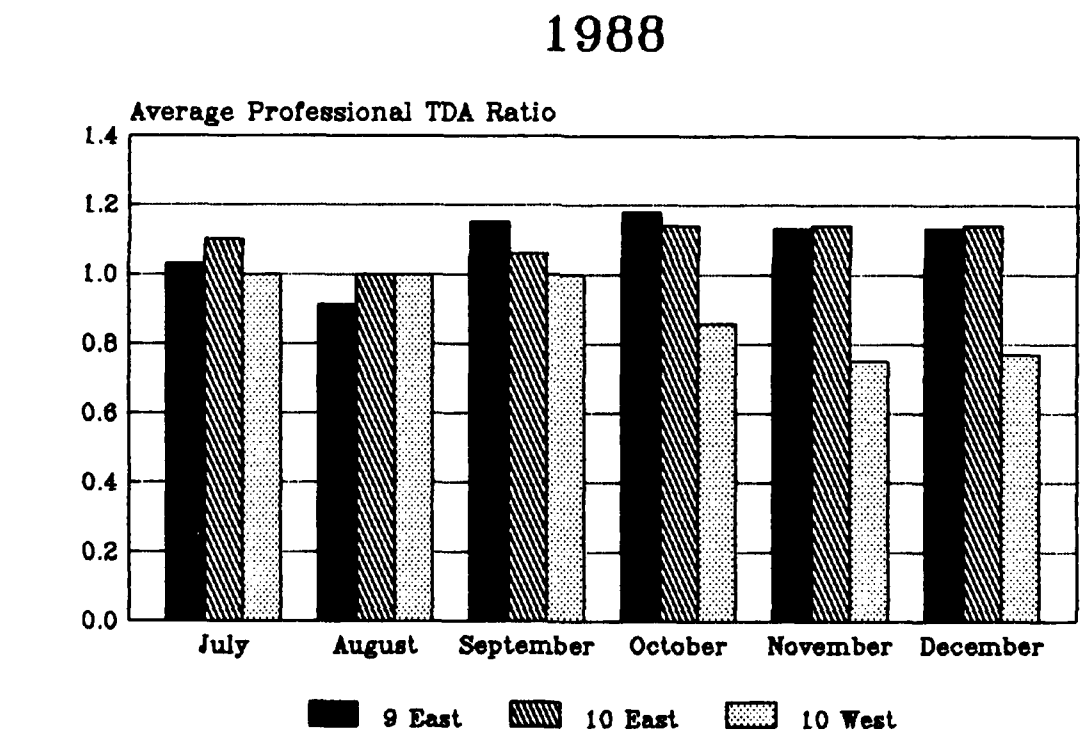
The negative correlation of the dependent variable to the Professional TDA Ratio indicates that professional staff depletions tended to occur with greater impact on utilization when the assigned unit professional staff was higher than authorized. A greater degree of enhanced utilization as a result of staff augmentations occurred when the assigned staff tended to

be lower than authorized. A period of a lower Professional TDA Ratio occurred only during a one month time frame that can be seen in Figure 1.

On the weekend/holiday evening shift, the degree of enhanced utilization as a result of augmentation of the professional staff occurred as a function of greater positive changes in census. The degree of diminished utilization as a result of professional staff depletions increased as a function of greater negative changes in census. These data indicate that this unit's professional staff's utilization improved by being augemented as the census rose, and diminished by having staff pulled as the census declined.

Ward 10 East. On the weekday day shift, the professional staff tended to become more overutilized as the degree of diminished utilization resulting from professional staff loss also became greater. Likewise, the greater the impact of staffing gains upon utilization, the greater was the tendency to have staff underutilized. It must be remembered, however, the t test results in Table 11 have shown that 10 East was the unit

Figure 1. Comparison of the Monthly Average Professional TDA Ratios for 9 East, 10 East, and 10 West.



December data from 1-18 Dec 88.

most likely to have professional staff pulled during this time frame. What this demonstrates is staff movements in or out of the unit tended to match the requirements of the WMSN in meeting the patient care needs.

On the weekday evening shift and the weekend/holiday day shift, the degree of diminished utilization as a result of professional staff augmentation increased at times when the ancillary staff was overutilized. Likewise, as the degree of enhanced utilization improved due to professional staff augmentation, the ancillary staff were correspondingly underutilized during the shift.

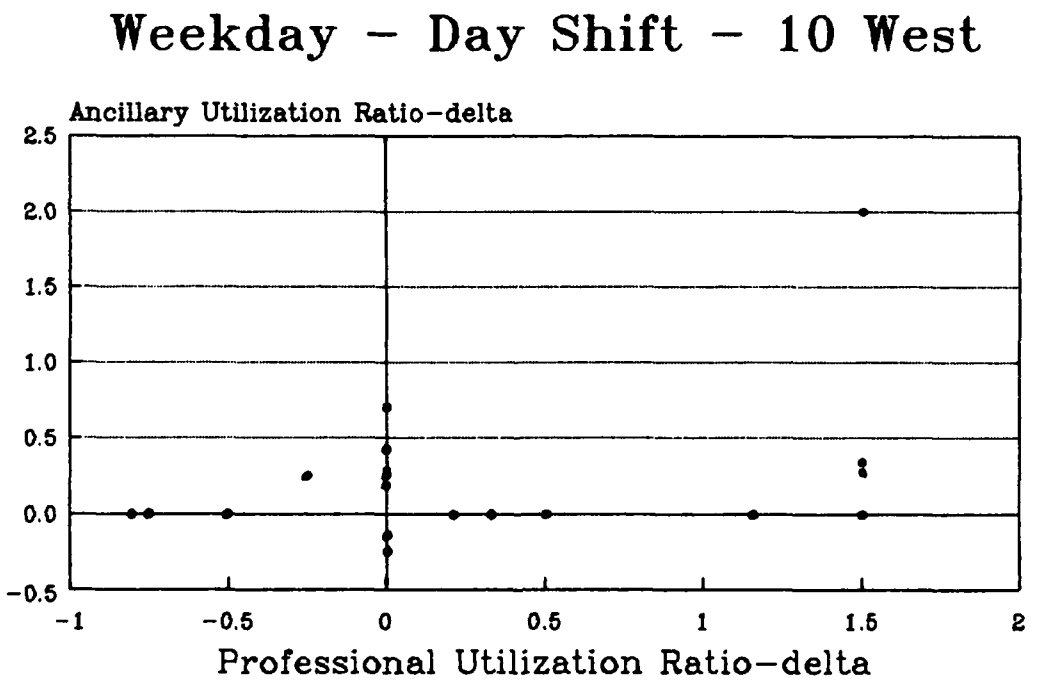
The positive correlation on the weekday evening shift to the Professional TDA Ratio would normally indicate that the degree of diminished utilization as a result of staff depletion increased when 10 East tended to have fewer professional staff than authorized by the TDA. This would not normally be considered a favorable correlation involving staffing movement. Figure 1, however, demonstrates that this unit was consistently either at or above its authorized TDA strength during the data collection period. A review of the data also reveals that staff was only pulled from this unit during this time period; this staff was never augmented during the weekday evening shift. The positive

correlation seen in this instance shows that as the unit was more overstaffed with relation to the TDA, the degree of diminished utilization as a result of staff loss tended to be greater.

Ward 10 West. During the weekday day and evening shifts, the degree of enhanced utilization resulting from staff augmentation to this unit was higher when this unit had fewer professional staff assigned than authorized by the TDA. Figure 1 demonstrates that this unit was either at or below its authorized strength during the data collection period. This is a favorable trend indicative of appropriate staff augmentation.

On the weekday day shift, the correlation analysis shows an association between the augmentation or pulling of the professional staff and the augmentation or pulling of the ancillary staff. Likewise, the positive direction of the correlation indicates that the degree of enhanced utilization of the professional staff increased as the degree of enhanced utilization of the ancillary staff increased. Figure 2 demonstrates that, in general, changes in the professional staff did not occur at the same time the ancillary staff was being pulled or augmented. The statistic is being primarily driven by an outlier value and the number of positive Ancillary Utilization Ratio-deltas, the majority of which did not occur with changes in the professional staffing.

Figure 2. Scatterplot of Professional Utilization Ratio-delta versus Ancillary Utilization Ratio-delta for 10 West.



Plots only for PUR and/or AUR delta >0

When the census was higher on the weekday evening shift there was an associated higher degree of diminished utilization of professional staff when staff was pulled. The lack of association with nursing care hours leads the author to suspect either coincidence, despite the p value, or greater need on the units to which the individuals were pulled. Unfortunately, the needs of the augmented unit were not a consideration in this study and the author's suspicions cannot be confirmed.

As 10 West lost or gained professional staff on the weekend/holiday day shift, the resulting degree of diminished utilization was correlated with greater overutilization or underutilization of the professional staff respectively.

Table 14.

Correlation of Professional Utilization Ratio-delta to Independent Variables on Weekdays-Day Shift Using Pearson's Product-Moment r

Independent Variable	9 East N=88	10 East N=88	10 West N=87
Census	n.s.	n.s.	n.s.
Census (delta)	n.s.	n.s.	n.s.
Nursing Care Hours	n.s.	n.s.	n.s.
PUR-Actual	.2928[a]	-.5899[b]	n.s.
Professional TDA Ratio	n.s.	n.s.	-.3774[b]
AUR-Actual	n.s.	n.s.	n.s.
AUR (delta)	n.s.	n.s.	.4172[b]
Ancillary TDA Ratio	n.s.	n.s.	n.s.

[a] $p<.05$

[b] $p<.001$

Table 15.

Correlation of Professional Utilization Ratio-delta to Independent Variables on Weekend/Holidays-Day Shift Using Pearson's Product-Moment r

Independent Variable	9 East N=48	10 East N=48	10 West N=48
Census	n.s.	n.s.	n.s.
Census (delta)	n.s.	n.s.	n.s.
Nursing Care Hours	n.s.	n.s.	n.s.
PUR-Actual	.2979[a]	n.s.	-.3408[a]
Professional TDA Ratio	n.s.	n.s.	n.s.
AUR-Actual	n.s.	-.4780[b]	n.s.
AUR (delta)	n.s.	n.s.	n.s.
Ancillary TDA Ratio	n.s.	n.s.	n.s.

[a] $p<.05$

[b] $p<.001$

Table 16.

Correlation of Professional Utilization Ratio-delta to Independent Variables on Weekdays-Evening Shift Using Pearson's Product-Moment r

Independent Variable	9 East N=88	10 East N=88	10 West N=87
Census	n.s.	n.s.	-.3190[b]
Census (delta)	n.s.	n.s.	n.s.
Nursing Care Hours	n.s.	n.s.	n.s.
PUR-Actual	n.s.	n.s.	n.s.
Professional TDA Ratio	-.2336[a]	.2289[a]	-.2638[a]
AUR-Actual	n.s.	-.2546[a]	n.s.
AUR (delta)	n.s.	n.s.	n.s.
Ancillary TDA Ratio	n.s.	n.s.	n.s.

[a] $p<.05$

[b] $p<.01$

Table 17.

Correlation of Professional Utilization Ratio-delta to Independent Variables on Weekend/Holidays-Evening Shift Using Pearson's Product-Moment r

Independent Variable	9 East N=48	10 East N=48	10 West N=48
Census	n.s.	n.s.	n.s.
Census (delta)	.3400	n.s.	n.s.
Nursing Care Hours	n.s.	n.s.	n.s.
PUR-Actual	n.s.	n.s.	n.s.
Professional TDA Ratio	n.s.	n.s.	n.s.
AUR-Actual	n.s.	n.s.	n.s.
AUR (delta)	n.s.	n.s.	n.s.
Ancillary TDA Ratio	n.s.	n.s.	n.s.

All r values have a significance of $p<.05$

Ancillary Staff Correlations

The following observations regarding the ancillary staff can be made from those r values on Tables 18 through 21 having a less than five percent probability of occurring by chance alone:

Ward 9 East. There was a positive functional relationship on the weekend/holiday day shift of improved ancillary staff utilization, as a result of staff augmentation, to a higher census. As the unit census became lower, the degree of ancillary utilization tended to diminish with staffing losses. The same functional relationship was seen on the weekend/holidays evening shift between nursing care hours and the degree of enhanced ancillary staff utilization when they were augmented.

The negative correlation of the dependent variable to the Professional TDA Ratio on the weekday evening shift indicates that ancillary staff depletions tended to occur with greater impact when the Professional TDA Ratio was higher. A greater degree of enhanced utilization of ancillary staff due to augmentations occurred when the assigned staff tended to be lower than authorized. It can be seen from Figure 3, however, that the Ancillary TDA Ratio for this unit not only remained significantly higher than the other units of this study, but also remained over its authorized strength.

Ward 10 East. Significant correlations on this unit were confined to the evening shift. On the weekdays there was a positive association between both the census and the nursing care hours when compared to the degree of enhanced or diminished utilization due to staff augmentation or depletion. Staffing gains tended to have a greater impact on staffing utilization during periods of higher census and nursing care hours, and vice versa. Staffing gains and their positive impact on the ancillary staffing utilization tended to occur when the Ancillary TDA Ratio was lower on the weekend/holidays. It can be seen in Figure 3 that this unit was consistently understrength during the data gathering period.

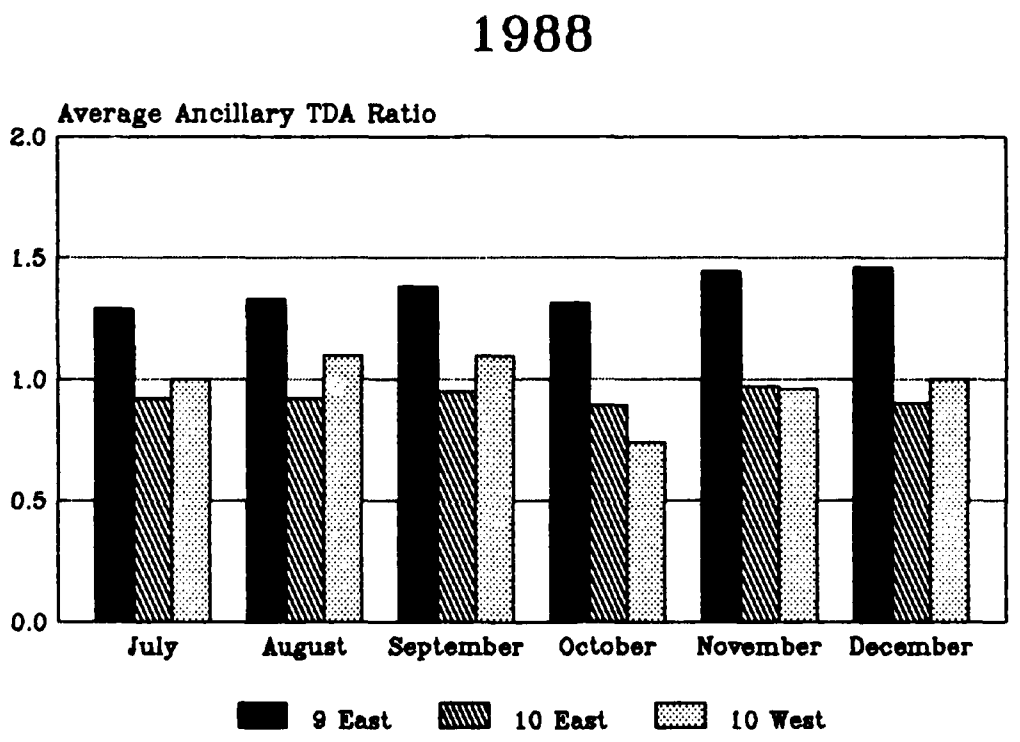
Ward 10 West. On the weekday day shift when the degree of diminished utilization due to ancillary staff losses was greater, there was a concomitant diminution of professional staff utilization with the loss of professional personnel. When the impact of ancillary staff loss was greater during this time frame, the ancillary TDA ratio tended to be more favorable to the loss.

During the weekend/holidays day shift, there was a negative association between the decline in staff utilization due to ancillary staff losses and nursing care hours. As the nursing care hours became greater, the degree of diminished ancillary staff utilization tended to be higher as the staff were

pulled and vice versa. The opposite correlation is seen on the evening shift in Table 21 when the degree of diminished ancillary staff utilization due to staff losses tended to increase as a positive function of nursing care hours. This trend is what one would more likely expect if staff movements were being based on nursing care requirements.

The positive correlation on the weekend/holiday evening shift between the Professional Utilization Ratio-actual and the ancillary dependent variable indicates that a greater under-utilization of the professional staff during the shift was accompanied by a greater degree of ancillary staff losses to other units. During the same time frame, a negative correlation of the dependent variable to the professional TDA ratio indicates that ancillary staff depletions tended to occur with greater impact when the assigned unit professional staff tended to be higher than authorized. A greater enhancement of ancillary staff utilization due to staff augmentations occurred when the professional TDA staff ratio tended to be lower.

Figure 3. Comparison of the Monthly Average Ancillary TDA Ratios for 9 East, 10 East, and 10 West.



December data from 1-16 Dec 88.

Table 18.

Correlation of Ancillary Utilization Ratio-delta to Independent Variables on Weekdays-Day Shift Using Pearson's Product-Moment r

Independent Variable	9 East N=88	10 East N=88	10 West N=87
Census	n.s.	n.s.	n.s.
Census (delta)	n.s.	n.s.	n.s.
Nursing Care Hours	n.s.	n.s.	n.s.
PUR (delta)	n.s.	n.s.	.4172[b]
PUR-Actual	n.s.	n.s.	n.s.
Professional TDA Ratio	n.s.	n.s.	n.s.
AUR-Actual	n.s.	n.s.	n.s.
Ancillary TDA Ratio	n.s.	n.s.	-.3104[a]

[a] $p<.01$

[b] $p<.001$

Table 19.

Correlation of Ancillary Utilization Ratio-delta to Independent Variables on Weekend/Holidays-Day Shift Using Pearson's Product-Moment r

Independent Variable	9 East N=48	10 East N=48	10 West N=48
Census	.3219[a]	n.s.	n.s.
Census (delta)	n.s.	n.s.	n.s.
Nursing Care Hours	n.s.	n.s.	-.3830[b]
PUR (delta)	n.s.	n.s.	n.s.
PUR-Actual	n.s.	n.s.	n.s.
Professional TDA Ratio	n.s.	n.s.	n.s.
AUR-Actual	n.s.	n.s.	n.s.
Ancillary TDA Ratio	n.s.	n.s.	n.s.

[a] $p<.05$

[b] $p<.01$

Table 20.

Correlation of Ancillary Utilization Ratio-delta to Independent Variables on Weekdays-Evening Shift Using Pearson's Product-Moment r

Independent Variable	9 East N=88	10 East N=88	10 West N=87
Census	n.s.	.3488[b]	n.s.
Census (delta)	n.s.	n.s.	n.s.
Nursing Care Hours	n.s.	.3204[b]	n.s.
PUR (delta)	n.s.	n.s.	n.s.
PUR-Actual	n.s.	n.s.	n.s.
Professional TDA Ratio	-.2194[a]	n.s.	n.s.
AUR-Actual	n.s.	n.s.	n.s.
Ancillary TDA Ratio	n.s.	n.s.	n.s.

[a] $p < .05$

[b] $p < .01$

Table 21.

Correlation of Ancillary Utilization Ratio-delta to Independent Variables on Weekend/Holidays-Evening Shift Using Pearson's Product-Moment r

Independent Variable	9 East N=48	10 East N=48	10 West N=48
Census	n.s.	n.s.	n.s.
Census (delta)	n.s.	n.s.	n.s.
Nursing Care Hours	.3838[b]	n.s.	.2955[a]
PUR (delta)	n.s.	n.s.	n.s.
PUR-Actual	n.s.	n.s.	.2922[a]
Professional TDA Ratio	n.s.	n.s.	-.3761[b]
AUR-Actual	n.s.	n.s.	n.s.
Ancillary TDA Ratio	n.s.	-.3418[a]	n.s.

[a] $p<.05$

[b] $p<.01$

Correlations Among Independent Variables

A closer examination of the correlation matrices reveals a number of significant trends among the independent variables. A consistent positive correlation between the census and nursing care hours on each nursing unit and for each time period is shown in Table 22. This is an expected trend since nursing care hours would always increase as the census increased. The individual patient acuities could explain the variations in the r values from unit to unit.

Table 22.

Correlation of Census to Nursing Care Hours Using Pearson's Product-Moment r

Shift	Day of Week	9 East		10 East		10 West	
		N	r	N	r	N	r
Day	Weekday	88	.6159	88	.8496	87	.7194
Day	Weekend/Holiday	48	.6850	48	.5790	48	.6703
Evening	Weekday	88	.6148	88	.7094	87	.6502
Evening	Weekday/Holiday	48	.6494	48	.5067	48	.6054

All r values have a significance of $p<.001$.

The r values for the evening shift are also consistently less when compared to the day shift for reasons that should be

obvious. Patient acuities are determined once a day on the day shift, and the r value represents a comparison of the acuities of the patient population with the day shift census. The r values for the evening shift represent a comparison of the acuities determined on the day shift with the census at the end of the evening shift. One would expect to see less of a correlation between the two variables.

The correlations of the Professional Utilization Ratio-actual with the variables of census, nursing care hours, Professional TDA Ratio, and the Ancillary Utilization Ratio-actual are presented in Tables 23-26 respectively. Likewise, the correlations of the Ancillary Utilization Ratio-actual with census, nursing care hours, and the Ancillary TDA Ratio are presented in Tables 27-29 respectively. These data give some insight into possible problems in making a workload management system function as a tool in the redistribution of staff. They also provide data regarding personnel management that might otherwise go unnoticed.

Table 23.

Correlation of Professional Utilization Ratio-actual to Census Using Pearson's Product-Moment r.

Shift	Day of Week	9 East		10 East		10 West	
		N	r	N	r	N	r
Day	Weekday	88	n.s.	88	n.s.	87	.3201[b]
Day	Weekend/Holiday	48	.3135[a]	48	n.s.	48	n.s.
Evening	Weekday	88	n.s.	88	n.s.	87	.3638[c]
Evening	Weekday/Holiday	48	.4039[b]	48	n.s.	48	n.s.

[a] $p<.05$

[b] $p<.01$

[c] $p<.001$

Table 24.

Correlation of Professional Utilization Ratio-actual to Nursing Care Hours Using Pearson's Product-Moment r.

Shift	Day of Week	9 East		10 East		10 West	
		N	r	N	r	N	r
Day	Weekday	88	.3229[b]	88	n.s.	87	.3027[b]
Day	Weekend/Holiday	48	.6050[c]	48	n.s.	48	.3138[a]
Evening	Weekday	88	n.s.	88	n.s.	87	.5280[c]
Evening	Weekday/Holiday	48	.3383[a]	48	-.5211[c]	48	.3452[a]

[a] $p<.05$

[b] $p<.01$

[c] $p<.001$

Table 25.

Correlation of Professional Utilization Ratio-actual to Professional Table of Distribution and Allowances Ratio Using Pearson's Product-Moment r.

Shift	Day of Week	9 East		10 East		10 West	
		N	r	N	r	N	r
Day	Weekday	88	n.s.	88	.3601[c]	87	-.5011[c]
Day	Weekend/Holiday	48	n.s.	48	n.s.	48	-.5517[c]
Evening	Weekday	88	-.2587[a]	88	-.2230[c]	87	-.3837[c]
Evening	Weekday/Holiday	48	n.s.	48	.2878[a]	48	-.4163[b]

[a] $p<.05$

[b] $p<.01$

[c] $p<.001$

Table 26.

Correlation of Professional Utilization Ratio-actual to Ancillary Utilization Ratio - Actual

Using Pearson's Product-Moment r.

Shift	Day of Week	9 East		10 East		10 West	
		N	r	N	r	N	r
Day	Weekday	88	n.s.	88	-.3287[b]	87	-.2816[b]
Day	Weekend/Holiday	48	.2894[a]	48	n.s.	48	.4095[b]
Evening	Weekday	88	.4099[c]	88	n.s.	87	.2236[a]
Evening	Weekday/Holiday	48	.3183[a]	48	n.s.	48	.3501[a]

[a] $p<.05$

[b] $p<.01$

[c] $p<.001$

The utilization of registered nurses on the day and evening shifts for weekends and holidays demonstrated a positive functional relationship with the census of the unit as shown in Table 23. This relationship was stronger when the utilization ratios were correlated with nursing care hours in Table 24. The almost universal positive correlation demonstrates the inability to meet the demands of patient acuity. If there was enough

staffing flexibility in terms of a surplus or contingent group of registered nurse, such as a float pool, available to meet the acuity needs, there should be no statistically significant correlation between nursing care hours and the Professional Utilization Ratio-actual.

Another management indicator of staff utilization can be demonstrated if one compares the professional utilization ratio with an indicator of overall staff availability. This is shown in Table 25. These data indicate that on all nursing units on the weekday evening shift, the utilization of professional staff was negatively correlated with availability of overall professional staff for the unit. This means when the nursing staff were underutilized, they tended to also have more personnel assigned to the unit as a function of those authorized by the appropriate TDA. This correlation is consistent for each of the four homogeneous time groups for 10 West.

This correlational descrepancy could be indicative of the system used to determine human resource allocation on the TDA to the various nursing units. The current TDA requirements are determined based on the average daily census. Table 22 clearly shows that patient care needs should not be equated with the census of the nursing unit. Correlations may not portray an accurate picture since an acuity measurement is used to determine only one of the variables being tested.

In the near future, the inpatient units will be allocated human resources according to the Manpower Standards Staffing Study application. This system of resource allocation will incorporate patient acuity information in its calculation of staffing requirements replacing the old manpower yardstick of average daily census. It will provide for the first time a connection with the unit staffing determination procedure and average patient acuity.

The discrepancy may also be explained by an inaccurate calculation of the patient acuities. Patient requirements may actually be higher than calculated. If this is indeed happening, requirements for professional staffing would be higher. Higher staffing requirements with the documented staffing levels would raise the professional utilization ratio. This could either reverse or make nonsignificant the positive correlation currently seen.

A final significant correlation, seen consistently on 9 East and 10 West, is that of the utilization of professional to ancillary personnel. There was a significant positive functional relationship between the two during the evening shift on the weekdays and during both shifts on the weekend/ holidays . When registered nurses were overutilized, the ancillary staff tended to be overutilized as well. The converse of this is also true. This could indicate a lack of attempts to balance professional

staffing shortfalls with ancillary overstaffing. If there was a statisically significant movement of ancillary staff onto a unit to balance professional shortfalls movements, then the statistic would appear as a negative correlation as is seen on 10 East and 10 West during the weekday day shift.

Table 27.

Correlation of Ancillary Utilization Ratio-actual to Census Using Pearson's Product-Moment r.

Shift	Day of Week	9 East		10 East		10 West	
		N	r	N	r	N	r
Day	Weekday	88	n.s.	88	n.s.	87	n.s.
Day	Weekend/Holiday	48	.4558[a]	48	n.s.	48	n.s.
Evening	Weekday	88	.3629[b]	88	n.s.	87	n.s.
Evening	Weekday/Holiday	48	.4413[a]	48	n.s.	48	n.s.

[a] $p<.01$

[b] $p<.001$

Table 28.

Correlation of Ancillary Utilization Ratio-actual to Nursing Care Hours Using Pearson's Product-Moment r.

Shift	Day of Week	9 East		10 East		10 West	
		N	r	N	r	N	r
Day	Weekday	88	-.3163[b]	88	n.s.	87	n.s.
Day	Weekend/Holiday	48	.4711[c]	48	n.s.	48	n.s.
Evening	Weekday	88	.3097[b]	88	.2827[b]	87	.2181[a]
Evening	Weekday/Holiday	48	.6102[c]	48	.3852[b]	48	.4361[b]

[a] $p<.05$

[b] $p<.01$

[c] $p<.001$

Tables 27 and 28 demonstrate similar ancillary staff correlations to those seen with the professional staff in Tables 23 and 24. While fewer correlations are seen, they demonstrate a positive functional relationship with census and, to a greater degree, nursing care hours. 9 East is the exception with a negative correlational trend on the weekday day shift indicating more ancillary staff than required by the WMSN during periods of higher nursing care hours and fewer staff than required when

the nursing care hours were less. Figure 3 indicates consistent overstrength in ancillary personnel during the data gathering period. The tendency to schedule more ancillary personnel during the weekday day shift could account for this discrepancy. A comparison of the Ancillary Utilization Ratios-actual among the three nursing units in Figure 4 would lend credence to the probability of this statement.

Again, the data demonstrate a consistent positive correlational trend can be seen during the evening shift between nursing care hours and the Ancillary Utilization Ratio-actual. Since this shift is usually the more austerely staffed of the two shifts studied, one would expect more restriction on the nursing supervisor's ability to shift resources to meet acuity needs.

Figure 4. Ancillary Utilization Ratio-actual During the Four Homogeneous Time Groups.

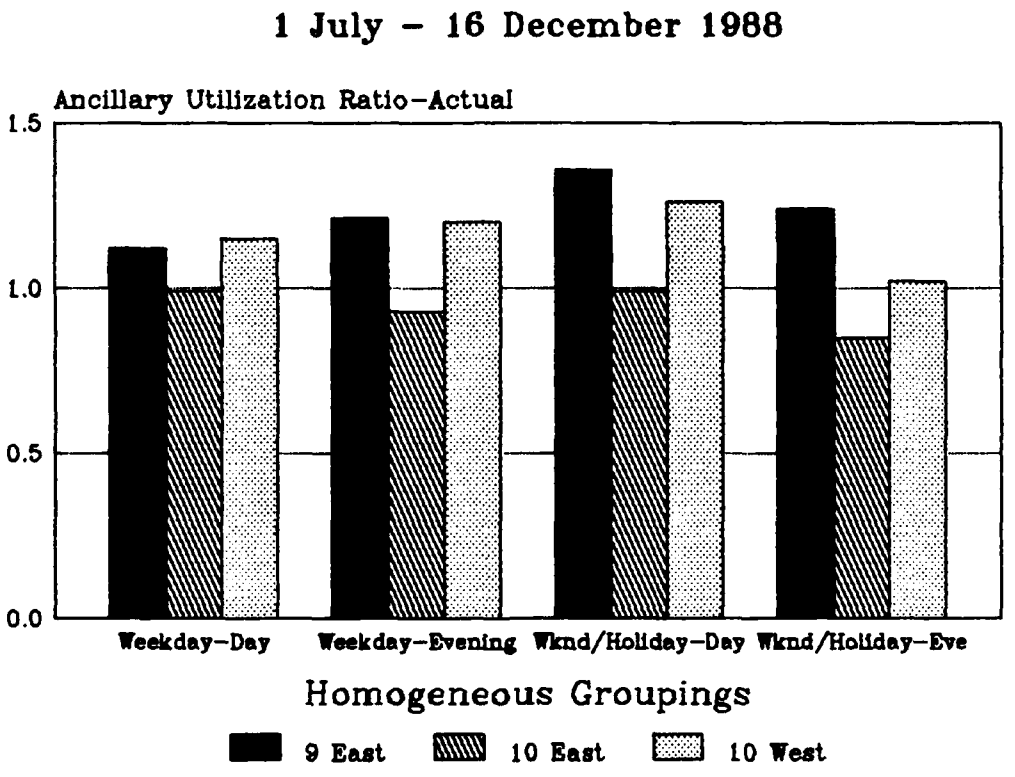


Table 29.

Correlation of Ancillary Utilization Ratio-actual to Ancillary Table of Distribution and Allowances Ratio Using Pearson's Product-Moment r.

Shift	Day of Week	9 East		10 East		10 West	
		N	r	N	r	N	r
Day	Weekday	88	n.s.	88	n.s.	87	.3728
Day	Weekend/Holiday	48	-.5032	48	n.s.	48	n.s.
Evening	Weekday	88	-.4867	88	n.s.	87	n.s.
Evening	Weekday/Holiday	48	-.6084	48	n.s.	48	n.s.

All r values have a significance of $p<.001$

The relationship of the Ancillary Utilization Ratio-actual to their TDA ratio is almost the reverse of that seen for the professional staff. The favorable negative correlations seen on 9 East with the professional staff only on the weekday evening shift, are seen for the ancillary staff on all but the weekday day shift. The only positive correlation of the ancillary utilization ratio-actual to the TDA ratio was on 10 West during the day shift. This indicates that fewer ancillary staff were on duty than were required by the WMSN to accomplish the work during

periods of time when the unit had more overall ancillary staffing and vice versa.

As was noted with the ward 10 East professionals and this particular correlation, two possibilities exist that may explain why this occurred. First, the Manpower Staffing Standard may inaccurately determine staffing requirements for this unit or the data used when the Standard was applied inaccurately reflected the units needs. A second possibility, and one that can be managed by the nursing unit, is one of the accuracy of determining the patient care requirements.

III. CONCLUSIONS AND RECOMMENDATIONS.

The data presented in this study provide supporting evidence that the movement of nursing staff is being driven, at least in part, by the WMSN. Therefore, the author concludes that this Department of Nursing is successfully implementing the Army's WMSN. However, a caveat must be made with this conclusion. Success was limited by the availability of nursing staff resources to be moved. It is repeatedly pointed out in the literature that a patient acuity system is only a management tool to assist in decision making and that supervisory nursing judgement must also play a role if and when staff are shifted.

Some of the statistics indicated unfavorable staffing trends such as the increasing workload demands and the inability of the nursing units to meet the demands. The lack of available nursing resources or the relative intrinsic inflexibility in scheduling resources to meet workload demands hampered supervisors in meeting acuity needs. This was particularly seen during the evening shift and the weekend/holidays, those times when staffing is traditionally lowest.

To be more "successful" in implementing the WMSN, it may be necessary to become less traditional in staff scheduling, since staff availability in military healthcare facilities is governed by the TDA, and the healthcare professional and ancillary staff market. One possibility is to convert some of the line and paragraph numbered civilian positions into optionally shared positions whereby two part time persons could be hired for one position. Another possibility is a mixing of twelve and eight hour shift workers. In order to determine the need and efficacy of doing this, there must be some ongoing management information generated from the WMSN data to better guide those scheduling decisions.

No one type of statistic proved to be more valuable than another in determining the success of the WMSN implementation. Each statistical measure had to be considered within the context of others. The meaning of many of the correlations was only

discovered when they were compared to the descriptive statistics. It is evident that more than one type of information report generated from the WMSN data would be needed to assess the staffing situation. Descriptive statistics and correlation studies presented in table and graphic forms would present a clearer picture to the manager.

The Utilization Ratio-delta did not prove to be as valuable a dependent variable in demonstrating staff movements as originally thought. The concept of positive and negative utilization units of measure as indicators of the impact of staff augmentation and losses can be confusing. It may be possible that using the number of Full Time Equivalents moved would prove more useful not only in comparing units but also in explaining the results.

One of the more valuable variables in this study was the Utilization Ratio-actual. In conjunction with other variables, it gave useful information regarding staff shifting and overall staff utilization when compared to the TDA. The information could also be used to compare utilization of the levels of providers on the same unit, as it was in this study. This would be useful information in demonstrating trends during the four identified homogeneous time groups. The need for staffing adjustments could be better pinpointed by unit and time frame.

One major drawback of this study is that it did not take into account seasonal differences. Since this study analyzed data generated over less than a 6 month period, there is no way to tell if there were seasonal differences in staffing adjustments. Two particular times of the year when patient census is higher in this facility were not studied. These times were the Acute Respiratory Disease season in January and February, and the Summer Surge, a period of increased trainee influx into the Post each May and June. Statistical smoothing techniques could prove useful in analyzing such trends.

The comparison of reciprocal unit needs when an staffing adjustments took place was another aspect of staff utilization not studied. The needs of the losing unit in terms of WMSN staff requirements were not compared with the needs of the gaining unit. This may have given better insight and justification to the need for staff shifting. The Utilization Ratio-Scheduled would be useful in this regard. Although it was only used in this study to assist in determining the Utilization Ratio-delta, it may be useful when examining staff utilization when compared to staff movements, nursing care hours, and TDA ratio.

The TDA Ratio and its significant correlations with actual staffing and the impact of staffing changes upon utilization were frequently cited in the study. Since the TDA Ratio does not change with the shift, but rather with the day, comparisons of

the overall daily staff utilization data rather than shift utilization data with the TDA ratio may yield more useful and meaningful information. However, unfavorable correlations with the TDA ratio in this study did lead to some insightful findings. Seasonal smoothing techniques may also yield important information if this ratio and its relationship to WMSN data is compared over a longer period of time. The importance of the ratio when used in comparison with the WMSN data has been demonstrated in this study, and its continued monitoring along with the WMSN data are suggested.

A heretofore unstated operating principle used by the author of this study was that no new data elements would be required to generate the information used in this study. It was the underlying intent of the study to use data that is currently being collected on a daily basis by one or more systems within the hospital. All of the data elements needed to generate utilization information for this study met this criterion. The reason for this criterion was to allow immediate implementation of utilization information monitoring if it proved useful without adding a new data element or elements to the data reporting mechanisms already in place.

One problem encountered in the data gathering process, however, was having to go to multiple data sources to extract the

many different data elements. Unit time schedules, Nursing 24 Hour Reports, UCAPERS printouts, and WMSN data being recorded by the medical supervisor were necessary for complete data information. These time consuming difficulties lead the author to recommend placement of staffing and WMSN data on each 24 hour nursing report. These data would include the elements currently being reported separately to the medical supervisor: (1) professional and ancillary staffing, and staffing adjustments by shift, (2) number of patients by category, and (3) total nursing care hours. A line could also be left blank for the utilization ratio calculations. This would consolidate, at least temporarily, all of the needed data in one place.

Since the 24 Hour Nursing Report is a form that is usually held for only a few months, a more permanent record of this data is desired. All of the data elements are reported using the UCAPERS system but they do not all appear together on a single document. None of the data is currently being transformed into the management information generated in this study. Another recommendation for future development of the UCAPERS reporting system and other systems automating the WMSN reporting system would be to include the utilization ratios as part of the reporting process. The data elements are in the system. It would be a relatively simple matter to add lines in the program to generate the ratios.

Staffing utilization information would be more valuable information to a Commander and hospital administration than actual nursing care hours and raw staffing levels. Important decisions, however, would be required of the nursing administration regarding the utilization information that are reported. One of these is the degree to which overutilization of various staffing levels is acceptable; how understaffed can a unit be relative to its patient's nursing needs. It is recommended that if this information is reported, the Chief Nurse, Commander, and Deputy Commander for Clinical Services, at a minimum, agree on "threshold levels" of staff utilization. At these levels, certain administrative actions could take place, such as the capping of beds, shifting of patients, and the use of agency nurses.

These thresholds may be based on correlation risk management studies with incident reports or agreed upon percentages of acceptable overutilization. The important point is that upper level management understands the information and agree upon acceptable actions based on the information. Use of the WMSN can be helpful to reduce some of the subjectivity involved when deciding the appropriateness of patient movement or bed capping. The current treatment facility regulation, MR 40-38, Coordinating

Patient Requirements for Nursing Care with Available Staff Resources, could be made more useful as a management tool with threshold utilization levels.

A final recommendation would be a follow-up study to compare the utilization ratios used in this study to the TDA ratios when the TDA based on the Manpower Staffing Standards Study is implemented. Some less favorable correlations were found in this study when the staffing allocation levels based on the average beds occupied were compared to actual professional and ancillary staff utilization ratios. It would be interesting to determine if similar correlations existed when the basis of the TDA and the utilization ratio were on the patient acuity system.

APPENDIX A

DEFINITIONS

Workload Management System for Nurses (WMSN): A patient classification instrument of factor evaluative design which requires a registered nurse to assess nine groups of factors related to direct patient care and assign an overall score to each factor. The assessment of care during the day shift is used to predict care requirements for the next 24 hours. The weighted scores are summed, and the patients are classified into one of six discrete categories. The WMSN staffing methodology is used for determining the actual nursing care requirements and the numbers and mix of personnel recommended for quality care. This system incorporates both direct and indirect care time.

Patient Classification: The grouping of patients according to an assessment of their nursing care requirements over a specified period of time.

Patient Category: The representative grouping of patients according to their nursing requirements. The WMSN consists of six categorize: A Category I patient requires minimal care whereas a Category VI patient requires intensive care.

Nursing Care Hour Requirements: Number of hours of nursing care time required for each category of patient based on assessment of their direct and indirect nursing care requirements. This is operationalized using six proctological patient care hour

requirement charts: Medical/Surgical, Pediatric, Critical Care, Psychiatric, Nursery, and OB/GYN.

Personnel Requirements: Number and mix of registered nurses and non-registered nurses (ancillary staff) required to care for the patient workload on the unit. This is operationalized using six charts: Medical/Surgical, Pediatric, Critical Care, Psychiatric, Nursery, and Obstetrics/Gynecology.

Utilization: The degree to which a resource is being used to accomplish a goal. Utilization can be operationalized by comparing actual number of resources available to accomplish a goal to a standard that represents ideal or optimal number of resources needed to attain a goal. Overutilization occurs when there are fewer resources are being used to accomplish a goal than required by the standard. Underutilization occurs when there are more resources being used to accomplish a goal than required by the standard.

APPENDIX B

OPERATIONAL DEFINITIONS

Full Time Equivalent (FTE). One FTE for the purposes of this study is equivalent to one person working a full eight hour shift. The amount of time the provider spent on duty was measured in full hours. If a provider worked six hours on a given shift, this would be recorded as 0.75 FTE (six hours divided by eight hours).

Scheduled staffing. The number of FTEs of professional and ancillary staff members that were scheduled to work on a particular shift.

Actual staffing. The number of FTEs present on a given day and shift to deliver patient care.

Recommended staffing. The number of professional and ancillary staff members recommended by the Workload Management System for Nurses (WMSN) staffing table to be on duty during a given shift based on the Nursing Care Hour (NCH) requirements of the patients present on the unit.

Shift staffing adjustments. A gain or loss of professionals or ancillary staff on a nursing unit during a given shift recorded as FTEs lost or gained.

Census. The number of patients physically present on a nursing unit during a given shift.

Census-delta. The difference in the number of patients on a unit from one shift to the next. The day shift was compared to the previous night shift, the evening shift was compared to the day shift, and the night shift was compared to the evening shift.

Level of provider. Professional personnel are Registered Nurses, either civilian or military. Ancillary or paraprofessional personnel are civilian or military licensed practical nurses, non-licensed practical nurses, nursing assistants, and unit clerks.

Day of the Week. Days of the week are divided into two separate groups. All Federal holidays, training holidays, and Saturdays and Sundays were considered Weekend-Holidays. All other days were considered Weekdays.

Table of Distribution and Allowances (TDA) Ratio. This ratio is determined by dividing the number of staff assigned to a particular nursing unit by the number of staff authorized that unit by the TDA.

Utilization Ratio-Scheduled. This is a ratio determined by dividing the scheduled staff by the WMSN recommended staff. Unit time schedules were used to establish the number of professional and ancillary staff, as Full Time Equivalents (FTE), scheduled to work on a particular day and shift.

Utilization Ratio-Actual. This ratio is determined by dividing the actual professional and ancillary staff working, as FTEs, on a particular shift by the WMSN recommended staff.

Utilization Ratio-delta. This ratio is determined by subtracting the Utilization Ratio-Scheduled from the Utilization Ratio-Actual to give a net change (DELTA) in the staffing ratio during the shift. It represents the positive or negative impact of staff utilization as a result of staffing augmentation or depletion respectively.

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